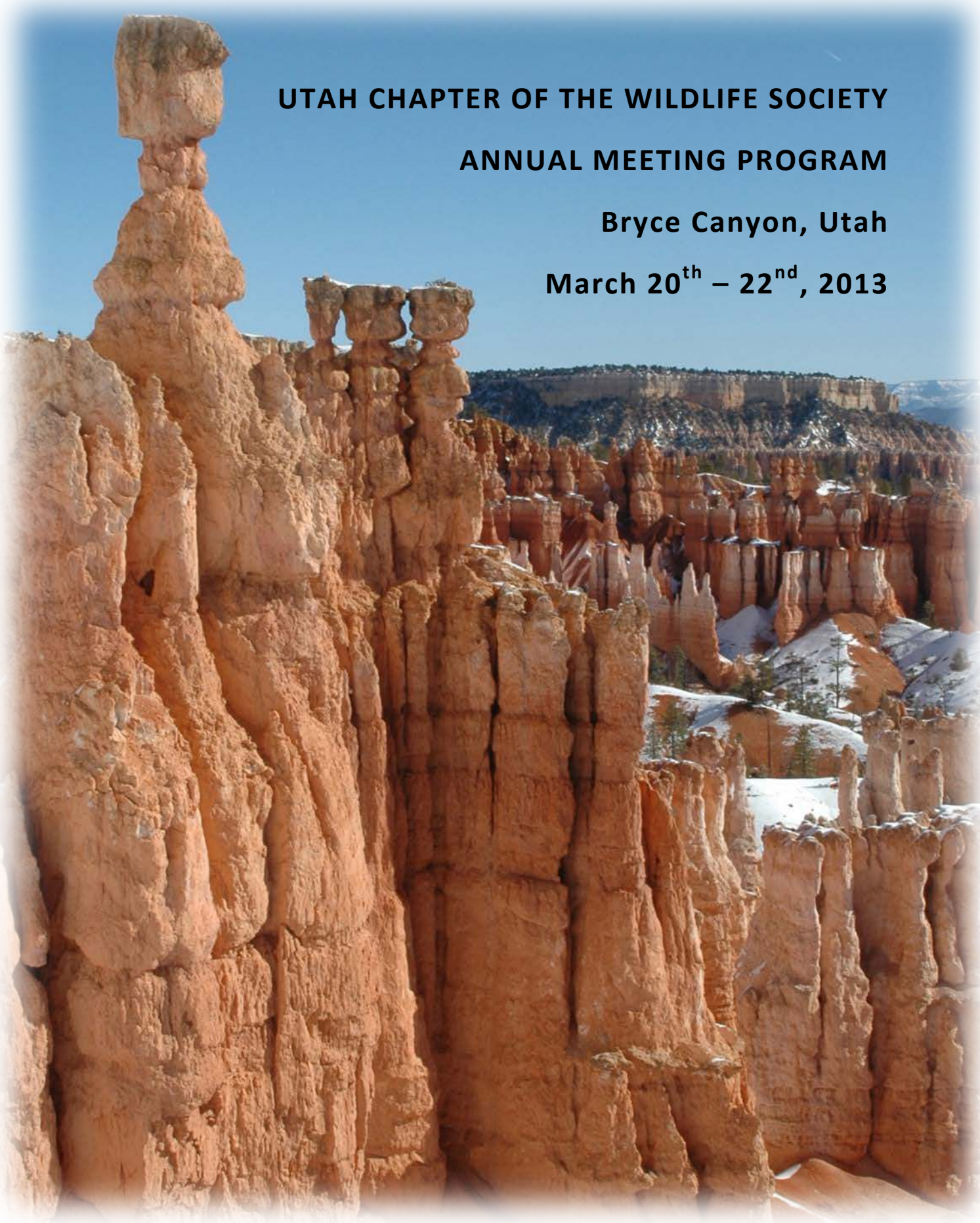

UTAH CHAPTER OF THE WILDLIFE SOCIETY

ANNUAL MEETING PROGRAM

Bryce Canyon, Utah

March 20th – 22nd, 2013

UTAH CHAPTER OF THE WILDLIFE SOCIETY

1965-2013

ANNUAL MEETING

Bryce Canyon, Utah

March 20th – 22nd, 2013

UTAH CHAPTER BOARD MEMBERS:

Carmen Bailey, President
Tom Smith, Past-President
Randy Larsen, President-Elect
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Robbie Knight, Even-Year Member
Avery Cook, Webmaster

Ruby's Inn
26 South Main Street
Bryce Canyon, Utah 84764
435-834-5341

OVERVIEW OF 2013 TWS MEETING

Wednesday, March 20th		
6:15 AM	Field Trips	See Website for Details
11:00 AM	TWS Registration	Ruby's Inn
1:00 PM	Welcome to TWS Meeting – Randy Larsen	
1:15 PM	Welcome to Bryce – Jeff Bradybaugh	
1:30 PM	Opening Remarks – Greg Sheehan	
1:45 PM	Invited Speaker – Dr. Tamara Goetz	
2:45 PM	Break	
3:15 PM	Invited Speaker – Dr. James Sheppard	
4:15 PM	Invited Speaker – Brad Hill	
5:15 PM	Adjourn until evening events	
6:30 PM	TWS Social	
7:00 PM	Quiz Bowl	
8:00 PM	Star Gazing – Kevin Poe	Bryce Canyon Visitor's Center
9:00 PM	"Scared of the Dark"– Kevin Poe	

Thursday, March 21st		
8:00 AM	TWS Registration	Ruby's Inn
8:30 AM	Announcements and TWS Business	
8:45 AM	Technical Session	
10:00 AM	BREAK	
10:30 AM	TWS Business	
10:45 AM	Technical Session	
12:00 PM	LUNCH	
1:30 PM	Technical Session	
2:45 PM	BREAK	
3:15 PM	Technical Session	
4:15 PM	Poster Session	
5:15 PM	Adjourn until evening events	
6:30 PM	Awards Banquet	

Friday, March 22nd		
8:00 AM	TWS Registration	Ruby's Inn
8:30 AM	Announcements and TWS Business	
8:45 AM	Technical Session	
9:45 AM	BREAK	
10:15 AM	Technical Session	
11:15 PM	Meeting Adjourn	

"For a successful technology, reality must take precedence over public relations, for nature cannot be fooled."

Richard P. Feynman

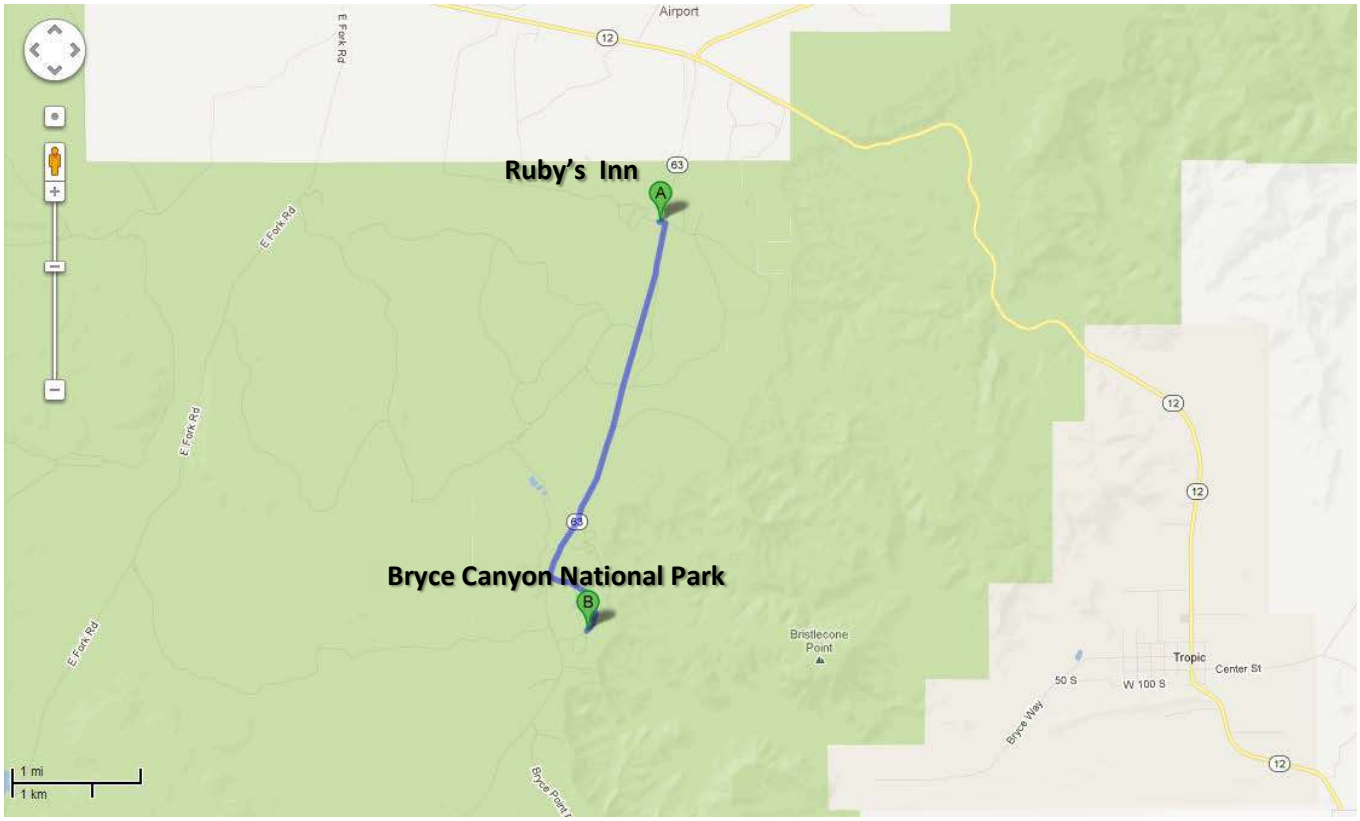
LOGISTICS AND FOOD

Bryce Canyon, Utah

Ruby's Inn Cowboy Buffet and Steakhouse. Steakhouses, Buffets (Yelp 2.5 Stars, $$). 1280 S. State Highway 63.

Foster's Family Steakhouse – American (traditional) (Yelp 3 Stars, $$). Route 12 B.

Subway - Sandwiches (Yelp 2.5 Stars, $$). 139 W. Highway 12.



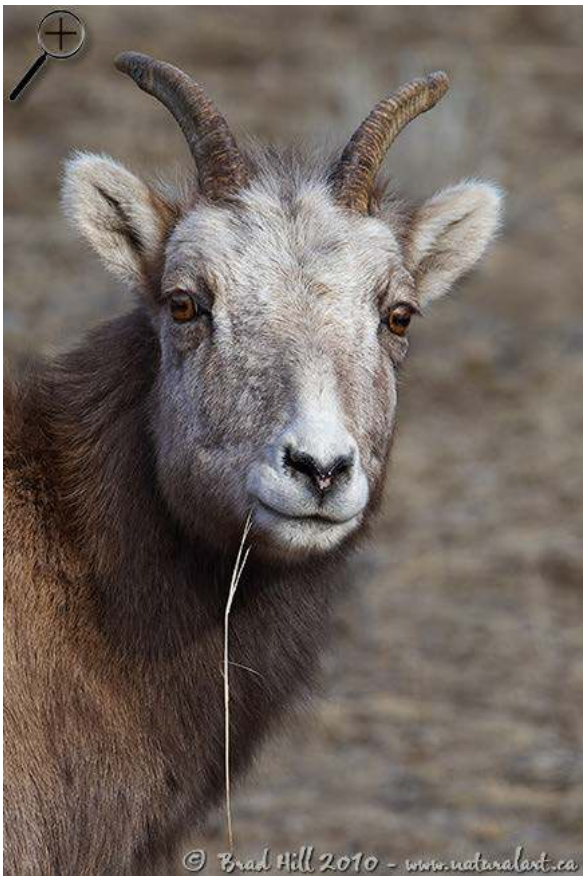
UTAH CHAPTER OF THE WILDLIFE SOCIETY, 2013

PLENARY SESSION

The rapid evolution and advancement of technology provides previously unimagined opportunities to monitor, manage, and study wildlife and their habitats. These advancements, however, also create challenges. This conference will provide a chance to reflect on the rapid advances in technology experienced during recent decades, the role of modern technology in informing both biology and wildlife management, and the future of conservation in an ever-changing world. Our plenary session this year will consist of three invited speakers who will highlight the role of technology in society, wildlife management, and conservation.

Dr. Tamara Goetz is the former State Science Advisor for Utah and was appointed by former Governor Jon M. Huntsman. Prior to this appointment, Goetz served as the director of the Salt Lake Community College (SLCC) Biotechnology Program for six years and helped to create educational programs and resources for students in Utah. After receiving a three-year Advanced Technology Education grant from the National Science Foundation in 2001, Goetz helped to create a one-year high school Biotechnology Program for juniors and seniors. Additionally, Goetz led InnovaBio, a student-driven, non-profit contract research company that provides high school and college students with opportunities to work as interns for a life science company. Since its creation, InnovaBio has been nationally recognized as an innovative partnership between education and industry that also supports economic development.

Dr. James Sheppard is an ecologist and wildlife biologist with a background in spatial ecology, landscape ecology and ethology. He has experience researching the ecology of diverse international taxa, including the spatial behaviors and habitat use of California condors, giant pandas, golden eagles, dugongs and desert tortoises. His research interests lie in the application of cutting-edge biotelemetry technologies, GIS and spatial modeling techniques to identify and characterize the ecology of threatened wildlife and habitats with a view to enhancing strategies for their conservation management. He is the founder and current director of the Ellen Browning Scripps Spatial Ecology Lab at the San Diego Zoo Institute for Conservation Research and currently serves as chair of the Spatial Ecology and Telemetry Working Group for The Wildlife Society.



Brad Hill is a full-time rabid nature photographer whose major focus is conservation. He resides in the southern Columbia Valley of British Columbia, wedged between the Rocky Mountains to the east and the Purcells to the west, with longtime partner Patti and their two almost human Portuguese Water Dogs - Jose and Poncho. The area in which he lives has been called the "Serengeti of North America". His photographic goal is to extract and expose the "natural art" that is all around us. One of his goals is to further conservation with pixels. His photography is “world class” and has been featured far and wide.

UTAH CHAPTER OF THE WILDLIFE SOCIETY

Bryce Canyon, Utah 2013

DETAILED MEETING SCHEDULE

Wednesday, March 20th		
6:15 or 9:00 AM	**Field Trips** Hosted by NPS and UDWR: In search of strutting greater sage grouse, hoodoos, and raptors.	**See Website for Specific Details**
11:00 AM	**TWS Registration**	**Ruby's Inn**
1:00 PM	**Welcome to TWS Meeting** Randy Larsen – TWS President Elect	
1:15 PM	**Welcome to Bryce Canyon National Park** Jeff Bradybaugh – Superintendent, Bryce Canyon National Park	
1:30 PM	**Opening Remarks** Greg Sheehan – Director, Utah Division of Wildlife Resources	
1:45 PM	**The Role of Technology in Modern Society** Dr. Tamara Goetz – Former Science Advisor for Utah	
2:45 PM	**BREAK**	
3:15 PM	**Exit Flatland: Movement-based Estimation and Visualization of Wildlife Space Use in 3D** Dr. James Sheppard – San Diego Zoo Institute for Conservation Research	**Ruby's Inn**
4:15 PM	**Into the Great Bear Rain Forest** Brad Hill – Nature Photographer, Natural Art Images	
5:15 PM	**Adjourn until evening events** *Dinner on your own*	
6:30 PM	**TWS Social – Light refreshments and appetizers**	
7:00 PM	**Utah TWS Quiz Bowl** Frank Howe and Brock McMillan	
8:00 PM	**Stargazing** Kevin Poe – Supervisory Interpretive Ranger, Bryce Canyon	**Bryce Canyon Visitor Center**
9:00 PM	**"Scared of the Dark"** Kevin Poe – Supervisory Interpretive Ranger, Bryce Canyon	

Thursday, March 21st		
8:00 AM	**TWS Registration**	
8:30 AM	**Announcements and TWS Business** Carmen Bailey – TWS President	
8:45 AM	**Orrin V. Duvuvuei, Natasha W. Gruber, Terry A. Messmer, and Rick J. Baxter** VITAL RATES, POPULATION TRENDS, AND RELATIVE CONTRIBUTION OF A TRANSLOCATED SAGE-GROUSE POPULATION IN NORTHEASTERN UTAH	
9:00 AM	**George V. Oliver and Anis Aoude** THE WHITE-TAILED DEER IN UTAH—MYTH OR REALITY?	**Ruby's Inn**
9:15 AM	**Sarah K. Haas** BALANCING BAT CONSERVATION AND HISTORIC BUILDING PROTECTION AT BRYCE CANYON NATIONAL PARK	
9:30 AM	**Alan G. Clark** UTAH'S GREATER SAGE GROUSE CONSERVATION PLAN	
9:45 AM	**Jonathan L. Fusaro** DNA-BASED MONITORING OF BLACK BEAR POPULATIONS USING HAIR-SNARES: A REVIEW OF TOOLS AND TECHNIQUES FOR USE IN URBAN AND WILDLAND BEAR HABITAT	
10:00 AM	**BREAK**	
10:30 AM	**Report on TWS Council Activities** Dr. Gary White – Board Member, TWS National	
10:45 AM	**Kristen S. Ellis, Randy T. Larsen, and John F. Cavitt** SNOWY PLOVER NEST SURVIVAL AT GREAT SALT LAKE, UTAH	
11:00 AM	**Maureen G. Frank and Michael R. Conover** IT'S A BIRD, IT'S A PLANE, IT'S….AN ENORMOUS MIGRATION! RADAR DATA SHOW WINTER DEPARTURE OF EARED GREBES FROM THE GREAT SALT LAKE	
11:15 AM	**Robert J. Delph and Robert N. Knight** IMPACTS OF MILITARY TESTING AND TRAINING ON GROUND-DWELLING ARTHROPOD AND HERPETOFAUNA COMMUNITIES	**Ruby's Inn**
11:30 AM	**Patricia C. Cramer and Ashley Green** THE STATE OF THE SCIENCE OF WILDLIFE CROSSINGS IN UTAH: 2013	
11:45 AM	**Mike Smith** 800 YEARS OF RAPTOR TRAPPING: HIGH-TECH, LOW-TECH, WHAT CAN TECHNOLOGY IMPROVE?	
12:00 PM	**LUNCH** *On your own – Check out page 4 for limited options*	
1:30 PM	**Julie Miller, Tom S. Smith, Janene Auger, and Hal Black** THE POST-DENNING ACTIVITIES OF THE AMERICAN BLACK BEAR (*URSUS AMERICANUS*) IN UTAH	
1:45 PM	**Hal L. Black** A BEAR FOR THE PUBLIC: VISITOR MANAGEMENT AT DENS, PUBLIC RELATIONS, AND VALUE OF LONG-TERM DATA	**Ruby's Inn**

Thursday, March 21st Continued		
2:00 PM	**Steven J. Dempsey, Eric M. Gese, Bryan M. Kluever, and Robert N. Knight** FINDING A FOX: AN EVALUATION OF DETECTION METHODS FOR A SMALL DESERT CARNIVORE	**Ruby's Inn**
2:15 PM	**Peter J. Mahoney, Julie K. Young, David C. Stoner, John A. Shivik, Sandra M.C. Cavalcanti, and Eric M. Gese** FIND THAT CACHE: IDENTIFYING PREDATION EVENTS THROUGH CLUSTERED GPS DATA	
2:30 PM	**Allison L. Jones** GREAT TECHNOLOGICAL INNOVATIONS? YES. BUT WHAT HAVE WE LOST?	
2:45 PM	**BREAK**	
3:15 PM	**Daniel D. Olson and John A. Bissonette** ROADS AND MULE DEER: A LOOK AT WHAT IS HAPPENING IN UTAH	**Ruby's Inn**
3:30 PM	**Chris Balzotti, Steve Petersen, Randy Larsen, Richard Forester, Mitchell Power, Jarom Randall, and Phillip Dennison** ECOLOGICAL MODELING OF GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*) HABITAT IN UTAH	
3:45 PM	**Kent Hersey, Heather Bernales, Tom Becker, Brad Crompton, Darren Debloois, Alex Hansen, Dale Liechty, Dax Mangus, Lowell Marthe, Vance Mumford, Jason Nichols, Randall Thacker, Dennis Southerland, and Guy Wallace** ESTIMATING MULE DEER DOE AND FAWN SURVIVAL IN UTAH	
4:00 PM	**TWS Business** **Justin Shannon, Treasurer**	
4:10 PM	**BREAK**	
4:15 PM	**POSTER SESSION** **Jay W. Olson, Wesley Larson, Rusty Robinson, BJ Kirschhoffer, and Tom S. Smith** APPLICATION OF TECHNOLOGY TO DOCUMENT POLAR BEAR MATERNAL DENNING BEHAVIORS **Jared J. Baxter, Jordan P. Hennefer, Rick J. Baxter, Randy T. Larsen, and Jerran T. Flinders** SURVIVAL OF GREATER SAGE-GROUSE CHICKS IN STRAWBERRY VALLEY, UTAH USING MICRO-TRANSMITTERS: DOES HANDLING TIME NEGATIVELY INFLUENCE SURVIVAL RATES? **Tom S. Smith, Stephen Herrero, and Mikyn Rehder** AN ANALYSIS OF ALASKAN BEAR ATTACKS: 1983-2012 **Daniel D. Olson, John A. Bissonette, and Chris Garrard** DETECTING MOVEMENT BARRIERS FOR WILDLIFE **Robert J. Edgel, Janet L. Pierce, and Randy T. Larsen** PYGMY RABBIT HABITAT SELECTION IN UTAH: DOES SAGEBRUSH (*ARTEMISIA* SP.) AGE INFLUENCE SELECTION?	**Ruby's Inn (second floor)**

Thursday, March 21st Continued

	POSTER SESSION cont. **Tiffany Sharp and Brock McMillan** EFFECTS OF FIRE AND SMALL MAMMALS ON SEEDLING ESTABLISHMENT IN DESERT PLANT COMMUNITIES **Jace Taylor, Steve Bates, Jericho Whiting, and Randy Larsen** COUNTING SHEEP DOESN'T PUT US TO SLEEP: COMBINING REMOTE CAMERA TECHNOLOGY WITH MARK-RESIGHT METHODS **Avery Cook, Brian Wing, Todd Black, and Terry Messmer** ANTHROPOGENIC INFLUENCES ON THE ECOLOGY OF GREATER SAGE-GROUSE IN NORTHWEST UTAH **Suzanne Dunken, Jeff Maughan, Rick Baxter, Brock McMillan, and Randy Larsen** GENETIC CONSEQUENCES OF TRANSLOCATION OF GREATER SAGE-GROUSE IN STRAWBERRY VALLEY, UTAH **Rusty Robinson, Tom S. Smith, and Justin Shannon** DETERMINING THE STATUS AND TREND FOR DESERT BIGHORN SHEEP IN THE NORTH SAN RAFAEL SWELL **Brian R. Wing and Terry A. Messmer** THE ROLE OF VEGETATIVE STRUCTURE, COMPOSITION, AND NUTRITION IN GREATER SAGE-GROUSE ECOLOGY IN NORTHWESTERN UTAH **David C. Smedley, Randy T. Larsen, and Brock R. McMillan** MOVEMENTS AND SURVIVAL OF TRANSLOCATED MULE DEER (*ODOCOILEUS HEMIONUS*) IN CENTRAL UTAH **Tom S. Smith, Julie A. Miller, and Cali Layton** A COMPARISON OF METHODS TO DOCUMENT ACTIVITY PATTERNS OF POST-EMERGENCE POLAR BEARS (*URSUS MARITIMUS*) IN NORTHERN ALASKA **Jared J. Baxter, Rick J. Baxter, and Randy T. Larsen** ESTIMATING GREATER SAGE-GROUSE CHICK SURVIVAL IN STRAWBERRY VALLEY, UTAH USING LUKAC'S YOUNG SURVIVAL FROM MARKED ADULTS IN PROGRAM MARK	**Ruby's Inn (second floor)**
6:30 PM	**Awards Banquet and Raffle (Sponsored by Pictureline)** Tom Smith – Past President	

Friday, March 22nd		
8:00 AM	**TWS Registration**	
8:30 AM	**Announcements and TWS Business** Carmen Bailey - President	
8:45 AM	**Kylan Frye Christensen, Steven J. Slater, and Markus Mika** WINTER LANDSCAPE USE BY RAPTORS IN WESTERN UTAH: ASSESSING HABITAT PREFERENCE IN GIS	
9:00 AM	**Steven J. Slater, Kylan W. Frye, and Robert N. Knight** GOLDEN EAGLE POPULATION DYNAMICS IN UTAH'S WEST DESERT	**Ruby's Inn**
9:15 AM	**Eric D. Freeman, Randy T. Larsen, Kent R. Hersey, Mark E. Peterson Charles R. Anderson Jr., and Brock R. McMillan** EFFECTS OF SEX RATIO ON REPRODUCTION OF MULE DEER: PREGNANCY AND PARTURITION SYNCHRONY/TIMING	
9:30 AM	**Theresa L. Pope** STATEWIDE OCCUPANCY OF RIPARIAN BIRDS IN UTAH	
9:45 AM	**BREAK**	
10:15 AM	**Bryan M. Kluever, Eric M. Gese, Steven J. Dempsey, and Robert N. Knight** A COMPARISON OF METHODS FOR MONITORING KIT FOXES AT DEN SITES	
10:30 AM	**Lucas K. Hall, Randy T. Larsen, Robert N. Knight, Kevin D. Bunnell, and Brock R. McMillan** WATER DEVELOPMENTS AND CANIDS IN TWO NORTH AMERICAN DESERTS: A TEST OF THE INDIRECT EFFECT OF WATER HYPOTHESIS	**Ruby's Inn**
10:45 AM	**Kimberley Asmus Hersey, Brian Maxfield, Keith Day, Anthony Wright, Masako Wright, Kevin Bunnell, and John Shivik** AMERICAN PIKA MONITORING IN UTAH USING MULTI-SEASON OCCUPANCY MODELS	
11:00 AM	**Casey J. Cardinal, Terry A. Messmer, and John W. Connelly** FACTORS INFLUENCING THE ECOLOGY OF GREATER SAGE-GROUSE ON THE BEAR LAKE PLATEAU AND VALLEY, IDAHO-UTAH	
11:15 PM	**Meeting Adjourn**	

UTAH TWS BOARD

CANDIDATES FOR ELECTION

PRESIDENT

RICK BAXTER – Rick grew up in rural northeastern Oregon, one of nine siblings. He's pretty proud of being a hick. He later moved to Utah to attend BYU. While attending school he had the opportunity to work seasonally for the UDWR and USFS doing plant, wildlife, and range work. He graduated from the Plant and Wildlife Sciences Department with a BS, MS, and PhD, working under Dr. Jerran Flinders. This began a 12-year love affair with sage grouse. After graduation he went to work for the BLM in Caliente, NV (he didn't know where it was either) for a year and a half doing all sorts of work in sage grouse and desert tortoise habitat. After that he switched over to working for the USFS, specifically a group called TEAMS. He now works virtually from home, going on-site as needed to projects throughout the U.S. and beyond. He continues to be involved in his passion of wildlife research and management, many times related to sage grouse ecology. He loves archery hunting, gardening, and making homemade candy.

CHRIS WOOD – Chris is the Habitat Program Manager in the Southeastern Region for the Utah Division of Wildlife Resources (UDWR). Originally from Las Cruces, he received his bachelor's degree at New Mexico State University and then headed to Montana where he received his MS in Animal and Ranges Science from Montana State University. Currently, he is actively involved in habitat restoration work on public and private lands and part of the partnership that is implementing Utah's Watershed Restoration Initiative. His experience includes planning and implementing habitat restoration projects in sagebrush steppe, aspen, riparian, and wetland habitats. When not at work, Chris can be found exploring Utah's mountains and canyons, running, swimming, or trying various cuisines.

ODD YEAR BOARD MEMBER

COVY JONES – Covy is the Wildlife Program Manager in the Central Region for the Utah Division of Wildlife Resources (UDWR). Originally from God's Country (AKA Castle Dale, Utah) he received his bachelor's degree at Utah Valley University in Biology and then started working for the Shrub Sciences Research Laboratory (USDA, Forest Service Research) doing dendrochronology and plant materials development work. In 2006 Covy somehow convinced the BYU Plant and Wildlife Science administration that he should be accepted to the MS program from which he graduated, in record time--four and a half years later. In 2008 Covy came to work for UDWR as the Native Forb Biologist, (a/k/a "flower guy") where he continued in plant materials development until 2010 when he took a position in the Central Region as the Habitat Restoration Biologist. Four weeks ago Covy accepted his current position in the Wildlife Section as the Wildlife Program Manager where he is leaning heavily on the wildlife biologists to now learn how to manage mobile populations with depredation capabilities; which as you can imagine, weren't big problems when he was working with plants. When not at work, Covy can be found hiking, hunting, or camping with his family hoping to catch a glimpse of some monster mule deer that everyone else has missed.

Meeting Abstracts

VITAL RATES, POPULATION TRENDS, AND RELATIVE CONTRIBUTION OF A TRANSLOCATED SAGE-GROUSE POPULATION IN NORTHEASTERN UTAH

Orrin V. Duvuvuei[1], Natasha W. Gruber[1], Terry A. Messmer[1], Rick J. Baxter[2]
[1]Department of Wildland Resources, Utah State University, Logan, UT 84322
[2]Department of Plant and Wildlife Sciences, Brigham Young University, Provo, UT 84602

Compared to other galliformes, greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) are longer lived and have lower reproductive output. Female survival, chick survival, and nest success are important to population growth and changes in any of these vital rates drive fluctuations within a population. Male lek attendance rates suggest that populations have declined range-wide with some local populations exhibiting dramatic decreases. Lek counts on Anthro Mountain in Duchesne County, Utah declined from 44 males in 2006 to 13 males in 2008. Since this decline occurred in a population where habitats were within published guidelines for sage-grouse, Utah Division of Wildlife Resources and Utah State University initiated a translocation project in 2009 to augment the population. Translocations have been successfully used as a management tool to augment extirpated or declining wildlife populations for both game and nongame species including native upland game birds. In the spring of 2009 and 2010, sixty female sage-grouse were translocated from Parker Mountain, Utah. Translocation protocols were based on long-term translocation research conducted in Strawberry Valley, which also included translocated sage-grouse from Parker Mountain. The purpose of this research is to: compare the survival of sage-grouse at the source population with resident and translocated sage-grouse on Anthro Mountain and Strawberry Valley, compare vital rates of resident and translocated hens, determine the relative contribution of translocated sage-grouse to the population on Anthro Mountain, and assess the effects of the translocation on Anthro Mountain's population four years after initial release.

THE WHITE-TAILED DEER IN UTAH—MYTH OR REALITY?

George V. Oliver[1] and Anis Aoude[1]
[1]Utah Division of Wildlife Resources, Salt lake City, Utah 84116

Mammalogists have long disagreed concerning the occurrence of the white-tailed deer, *Odocoileus virginianus*, in Utah. Some authors have claimed that the species does not occur in Utah, others have asserted that it does occur in Utah, still others have alleged that it formerly occurred in Utah but is no longer present, and yet others have published inconsistent accounts, stating in their texts that it does not occur in Utah while providing maps that indicate that it does. We review the historical evidence, which shows that *O. virginianus* has been present in Utah since European settlement in the mid-19th century. We present new data and conclude that that *O. virginianus* occurs throughout much of north-central and northeastern Utah and that its current distribution in Utah is approximately as it was in the mid-19th century. We report the first museum specimen of *O. virginianus* from Utah, identify the subspecies as *O. v. dacotensis*, and discuss possible hybridization of *O. virginianus* with *Odocoileus hemionus*, the mule deer, in Utah.

BALANCING BAT CONSERVATION AND HISTORIC BUILDING PROTECTION AT BRYCE CANYON NATIONAL PARK

Sarah K. Haas[1]
[1]Biologist, National Park Service, Bryce Canyon National Park, Bryce, UT 84764

Bats have been observed roosting in historic structures at Bryce Canyon National Park for several years. In 2008, large numbers of bats emerging from the attic of the Bryce Lodge caused concern for visitor and employee safety as well as building preservation. The Bryce Lodge is a National Historic Landmark and a key cultural resource for the park. A total bat exclusion of the building was proposed and work was completed during the fall of 2012. Prior to exclusion work, three types of acoustic bat detectors (Pettersson D240x and D500x, Wildlife Acoustics SM2+BAT) were deployed at the Bryce Lodge and Sunrise Store to determine the seasonal time period in which bats were arriving and departing the structure and to assist with identifying species composition in the area. Bat detectors were deployed for 17 nights between March and October at the two historic structures. A total of 1,755 bat calls were recorded of sufficient quality to be identified using Sonobat 3.1 software from all detector types. Fifteen species of bat were identified with a discreet probability of .90 or greater, with some rare calls analyzed individually. Monitoring of the Bryce Lodge and surrounding area using acoustic detectors as well as mist netting is planned for 2013 to assess effects on bat movement, re-colonization of buildings and changes to species composition following exclusion.

UTAH'S GREATER SAGE-GROUSE CONSERVATION PLAN

Alan G. Clark[1]
[1]Utah Division of Wildlife Resources, Salt lake City, Utah 84116

In March, 2010, the U.S. Fish and Wildlife Service found that the Greater Sage grouse was warranted for listing under the ESA on a range-wide basis but was precluded due to higher listing priorities. In a subsequent court settlement agreement the Service agreed to make a final decision by the end of 2015. States within the Greater Sage-grouse range have undertaken updates or preparation of state plans. In Utah, Governor Herbert chartered a Working Group to develop a statewide conservation plan. With additional input from other interested groups, a plan has been drafted and presented to the Service. The Utah plan contains several unique approaches designed to meet the needs of Greater Sage-grousE in Utah. An overview of the key features of the Utah plan will be presented.

DNA-BASED MONITORING OF BLACK BEAR POPULATIONS USING HAIR-SNARES: A REVIEW OF TOOLS AND TECHNIQUES FOR USE IN URBAN AND WILDLAND BEAR HABITAT

Jonathan L. Fusaro[1]
[1]Department of Wildland Resources, Utah State University, Logan, UT 84321

DNA-based capture-mark-recapture (CMR) studies of black bear (*Ursus americanus*) populations are improving biologists' ability to monitor population trends and better manage the species at the local scale, regional scale, and statewide. The most cost effective and common method of obtaining DNA from black bears for CMR is through the use of hair-snares. Numerous hair-snare types and attractants to lure bears into hair-snare stations have been tested. These tools and techniques have primarily been implemented in wildland bear habitats and not in urban bear habitats. Using preliminary results of my masters' research

conducted in Mono County, California and findings in peer-reviewed literature, I will review the efficacy of the available tools and techniques used to collect bear hair and the attractants used to lure bears to the hair stations. Specifically, I will address how each tool and technique affects model assumptions and compare costs and practicality of use. In addition, I will compare the use of these tools and techniques in urban habitat to those in wildland habitat.

SNOWY PLOVER NEST SURVIVAL AT GREAT SALT LAKE, UTAH

Kristen S. Ellis[1], Randy T. Larsen[1], and John F. Cavitt[2]
[1]Department of Plant and Wildlife Sciences, Brigham Young University, Provo, UT, 84602; [2]Department of Zoology, Weber State University, Ogden, UT 84408.

Snowy plovers (*Charadrius nivosus*) are a small, ground nesting shorebird of conservation concern throughout their range. Reduced nest survival is considered a primary cause for the decline of snowy plover. Previous estimates of nest survival from the Great Salt Lake, however, have suffered from low sample sizes. Moreover, the influence of climate and habitat variables on nest survival has not been assessed at this important shorebird conservation area. We monitored fate of 589 snowy plover nests from 5 sites at Great Salt Lake in 2003, 2005-2010, and 2012. We used Program MARK to model daily survival rates of these nests and evaluate hypotheses about spatial and temporal variation in nest survival and the influence of habitat features. We used a 4-stage hierarchical modeling procedure and identified 6 competing models ($\Delta AIC_c < 2$). These competing models included the influences of study site and year on a linear time trend, and covariates quantifying nest age, temperature, precipitation, and nesting substrate (mudflat, vegetation, or dike). We noted a positive relationship between daily survival rate and age of nest ($\beta = 0.04$, 95% CI = 0.02 – 0.07) as well as between minimum daily temperature and daily survival rate ($\beta = 0.05$, 95% CI = 0.01 – 0.10). Conversely, we found a negative relationship between daily survival rate and the use of dikes ($\beta = -0.26$, 95% CI = -0.80 – 0.28) or barren mudflat ($\beta = -0.10$, 95% CI = -0.22 – 0.19) for nesting and between precipitation and daily survival rate ($\beta = -0.05$, 95% CI = -0.08 – -0.02). Among unsuccessful nests (48%, $n = 284$), we attributed failure to predation (70%, $n = 200$), flooding (9%, $n = 26$), nest abandonment (9%, $n = 25$), unviable eggs (2%, $n = 5$), and human activity (3%, $n = 9$). We could not determine the cause of failure at 7% ($n = 19$) of unsuccessful nests. Daily survival rate ranged from 0.99 to 0.74 and varied annually and spatially while generally following a linear time trend. Our results indicate that predation, as well as significant rainfall and low temperatures can influence snowy plover nest survival at the Great Salt Lake.

IT'S A BIRD, IT'S A PLANE, IT'S… AN ENORMOUS MIGRATION! RADAR DATA SHOW WINTER DEPARTURE OF EARED GREBES FROM THE GREAT SALT LAKE

Maureen G. Frank[1], Michael R. Conover[1]
[1]Wildland Resources Department, Utah State University, Logan, UT 84322

Although biological targets have been detected on radar data for years, ornithologists, entomologists, and mammalogists have only recently begun to use that data to track birds, insects, and bats. Typically, a flock of birds passing over a radar station is recorded as a "donut" pattern of color. However, flocks of birds and swarms of insects may be difficult to differentiate and it is not possible to determine species of birds from radar data. Tracking the winter migration of eared grebes (*Podiceps nigricollis*) from the Great Salt Lake is possible because there are no insects flying during their migration period (December), and there are no other species of birds migrating through this area at this time. Eared grebes do not show up on the radar in the typical pattern because they take off south of the radar station and do not pass over it. Rather, they are

seen on radar as a line that moves from the south part of the Great Salt Lake to the south. Publically available radar data has been recorded since 1995. This study is still in progress and only presents data for the past three winter migrations. When all the data have been examined, we will be able to observe variations in the main dates on which grebe migration takes place and whether these dates correlate with photoperiod, temperature, or food supply.

THE IMPACTS OF MILITARY TESTING AND TRAINING ON GROUND-DWELLING ARTRHROPOD AND HERPETOFAUNA COMMUNITIES

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The purpose of this study was to document the impacts of military testing and training on the ground-dwelling arthropod and herpetofaunal communities of Dugway Proving Ground, Dugway, UT. The major objective of monitoring ground-dwelling arthropods and herpetofauna was to (1) determine if there were any difference in species composition and abundance of ground-dwelling arthropods and herpetofauna associated with environments experiencing differing levels of anthropogenic disturbances resulting from military testing and training; (2) establish a baseline data set of habitat types with high diversity and low diversity of wildlife. Pitfall traps were used to quantify ground-dwelling arthropod and herpetofauna dynamics in response to environmental disturbances. This tested the hypothesis that with the high levels of environmental disturbance arthropod and herpetofauna abundance, species richness and community composition changed. Analysis of arthropod and herpetofauna abundance and species richness between environments with high and low levels of disturbance showed significantly more arthropods in heavily impacted environments but significantly higher diversity of arthropods in environments less impacted by military testing and training. Herpetofauna community mirrored the arthropod community but not significantly with only a few species being heavily responsive to environmental disturbances. Several species were identified as indicators for environments of high or low levels of environmental disturbance. Understanding how ground-dwelling arthropods and herpetofauna are affected by environmental disturbances can help land managers make informed decisions on land management practices and development.

THE STATE OF THE SCIENCE OF WILDLIFE CROSSINGS IN UTAH: 2013

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Utah has been building wildlife crossings since 1975, with more than 30 placed across the state. This six year study of wildlife crossings and other structures throughout Utah has revealed different species' preferences in passing under and above roads. This camera trap study examined how wildlife used 15 wildlife crossing bridges and culverts, and 23 existing structures. The objectives of our study were to evaluate the effectiveness of wildlife crossing bridges and culverts with regard to structure type and dimensions, and the effect of wildlife exclusion fencing as a retrofit technique at existing box culverts to increase mule deer and elk use. Using cameras placed at culvert and bridge entrances, we examined photos of both animals that used the structures and those that approached and then repelled away. The cameras produced over 2 million pictures during more than 40,000 camera nights of operation. Statistical tests were performed on structure dimensions and mule deer use of culverts. Individual mule deer were recorded

moving successfully through these structures on more than 30,000 occasions. All of the designated wildlife crossing bridges and culverts were used by mule deer. Success rate at each structure or site was defined as the number of successful individual animal movements through divided by the total number of approaches. Bridged wildlife crossings had higher success rates for mule deer (89 to 98%) compared to wildlife crossing culverts (50 to 98%). Culvert length was the most important dimension relative to mule deer crossing success rates; the shorter the length, the greater the success rate. Elk, moose, and carnivore passages were also documented. Recommendations designs for wildlife crossing structures include open bridges, culverts well under 200 feet long, structures in conjunction with streams and water features, and the installation of wildlife exclusion fencing.

800 YEARS OF RAPTOR TRAPPING: HIGH-TECH, LOW-TECH, WHAT CAN TECHNOLOGY IMPROVE?

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The need or desire for humans to live trap raptors has been practiced by ancient people groups for hundreds if not thousands of years. Middle East, Asia and European people groups used trapped birds of prey as a hunting tool to acquire food for their table. The use of live "trained" raptors for hunting led to the need to develop capture methods that left the bird uninjured and capable of flight. Tools and materials used to construct those ancient traps and trapping devices would be and are considered primitive by today's standards. With the exception of developed countries trapping techniques used today in most countries vary little from the methods used hundreds of years ago. Modern technologies and modern materials incorporated into old techniques have greatly improved the efficiency of the tools used to live trap raptors as well as improving the safety of the raptors being trapped. This paper will discuss the use of modern materials and technologies that are currently being used to live trap raptors at the Salt Lake Int'l Airport in hopes of providing useful information for those needing to live trap raptors for whatever reason.

THE POST-DENNING ACTIVITIES OF THE AMERICAN BLACK BEAR (*URSUS AMERICANUS*) IN UTAH

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Understanding the denning behaviors, timing of den emergence, and timing of den departure of female black bears (*Ursus americanus*) in Utah will help biologists establish best management practices. We investigated these behaviors by placing motion-sensing cameras at 34 dens from February to April, 2011 and 2012. Each camera was programmed to take two pictures with a one second delay between triggers, providing nearly continuous footage of bears at their dens. We documented emergence dates, departure dates, duration of time spent at den, and behaviors outside the den. Mean emergence date for all bears was 15 March (range of 28 February - 6 April, SD ± 11 d, n = 30). There was no difference in emergence date between the bear cohorts (females with cubs, females with yearlings, and lone females). Mean number of days between emergence and departure for all bears was 17 days (range of < .01 – 47 d, SD ± 18 d, n = 19). Mean departure date was 2 April (range of 9 March – 8 May, SD ± 17 d, n = 19). When comparing the departure dates of the different cohorts, we found that females with cubs departed their dens later than females with yearlings. Neither females with cubs nor females with yearlings were significantly different

from lone females. Mean departure date for females with cubs was 15 April (range of 24 March – 8 May, SD ± 15 d, n = 8); mean departure date for females with yearlings was 14 March (range of 9 March – 29 Mar, SD ± 10 d, n = 4); mean departure date for lone females was 1 April (range of 23 March- 21 April, SD ± 11 d, n = 6).

A BEAR FOR THE PUBLIC: VISITOR MANAGEMENT AT DENS, PUBLIC RELATIONS, AND VALUE OF LONG-TERM DATA

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Agency, university, and private outreach efforts to promote conservation and appreciation of bears include books, newsprint, displays, photos, TV, speeches, or other media; but nothing conveys excitement and reality more than seeing a bear anesthetized at your feet, where it can be touched, smelled, and heard. For this reason, we have invited over the past 20 years a variety of guests (students, friends, family, neighbors, hunters, politicians, doctors, lawyers, youth groups, colleagues, etc.) to visit hibernating adult female black bears and their offspring. One female was seen in her den every year but one from 1992 until her death in 2011 and has perhaps been seen in a den by more people than any other bear in North America. We document her reproductive outcome compared to other monitored females and comment on den types/accessibility and visitor outcomes. We share our techniques for managing people to minimize various risks to guests, institutions, and bears and to maximize potential for a quality, educational, up-close experience with a hibernating bear. We appeal to all in the state involved in black bear den work to share their research in the multidimensional world that fieldwork permits. This information is timely given that the Utah Division of Wildlife Resources has recently started to include visitors to dens. And now, with the onset of statewide monitoring of females, the UDWR has officially designated at least one bear in each region to be a bear for the public. In addition to the relations bonanza that public bears provide, den visits allow for continued monitoring of female reproductive success, the accumulation through time of individual histories, and a host of ancillary observations incident to winter bear work. We discuss the scope and potential analyses of the long-term BYU dataset.

FINDING A FOX: AN EVALUATION OF DETECTION METHODS FOR A SMALL DESERT CARNIVORE

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The kit fox (*Vulpes macrotis*) was once thought to have occupied the desert and semi-arid regions of southwestern North America, stretching from southern Oregon and Idaho to central Mexico. Recently, their population is suspected of being in decline and is now listed as a species of special concern in Utah, endangered in Colorado, protected non-game species in Idaho, and threatened in Oregon. Although there is an increasing awareness of potential threats to the kit fox, study of this species' abundance is lacking with the majority of studies focused on the more visible urban subspecies ,the San Joaquin kit fox (*V. macroitc mutica*), thereby leaving a need for greater knowledge of monitoring methods for the entire species across its range. Relative abundance estimates may be attained for the kit fox using common methods for

censusing wild canids. We evaluate the detection rates for kit fox of four methods (scent stations, scat deposition surveys, spotlight surveys, and capture) on the Dugway Proving Grounds, Utah. We found that scat deposition surveys had both the highest detection rates and highest correlation to known fox abundance. Detection was highest during the breeding season, which is ideal for monitoring the resident population. Scent stations were also found to be effective at detecting kit fox but were hindered by weather, especially during the fox breeding season. We recommend the use of scat deposition surveys to detect fox presence due to their relative low cost, robustness to weather, and high detection rates and correlation to fox abundance.

FIND THAT CACHE: IDENTIFYING PREDATION EVENTS THROUGH CLUSTERED GPS DATA

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Non-parametric kernel density estimators are commonly used to classify home ranges or utilization distributions from animal location data. Here, we extend the r-LoCoH estimator of Getz *et al.* (2007) using time-constrained convex hulls. This extension was originally developed with the intent of identifying predation events using global positioning system data derived from predator space-use monitoring efforts, but can be applied to any system where frequent and accurate relocation data are available and relocation clustering in space and time are indicative of behaviors of interest (i.e. denning, nesting). The present method is wrapped in a Python program called Program Cluster to allow easy and rapid implementation by users with limited programming knowledge. The output from Program Cluster resembles a fragmented utilization distribution, with each fragment corresponding to areas identified as intensely used in the location data based on user-specified spatial and temporal tuning parameters. Further, each fragment can be interpreted as an individual utilization distribution with more heavily shaded regions (i.e. greatest hull overlap) corresponding to areas with the highest intensity of use. We discuss the extended r-LoCoH method, program implementation, and output in the context of two predator studies: a historical jaguar (*Panthera onca*) prey study in the Pantanal, Brazil and an on-going predator study on Monroe Mountain, Fishlake National Forest, Utah.

GREAT TECHNOLOGICAL INNOVATIONS? YES. BUT WHAT HAVE WE LOST?

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This year's UTWS meeting is focusing on great technological gains made recently in the fields of wildlife biology and applied ecology. Impressive field innovations ranging from use of cell phone apps to record road kill data, to GPS tracking devices running off of satellites, to "critter cams" all enable the field biologist to spend less time in the field; lots of good, recordable and analyze-able data can stream to the field biologist in the comfort of his office. In addition, complex simulating annealing algorithms and GIS-based modeling programs enable entire studies on things like dispersal and population dynamics and viability to be conducted on a computer and then published in the journals. But, while enjoying these new technological innovations, we must ask ourselves: what is being lost? What have we lost in terms of simple, observation-based studies and hours and hours spent watching and writing in field notebooks out in

the field? Are we remembering to teach students and new hires, and try to instill in them, a love of natural history? What exactly is "natural history"? Fleischner (2005) defines it as "a practice of intentional focused attentiveness and receptivity to the more-than-human world, guided by honesty and accuracy." Careful observation and description – the cornerstones of natural history – are the basis of all good science. Empirical observations provide the framework upon which integrative theories can be draped. My presentation will be brief to allow time for maximum discussion – I will simply outline some key concepts from other authors who have recently written on the importance of natural history, and what is currently being lost from our society. And I am not just referring to The Wildlife Society, but indeed all society. I will argue that the world needs to understand, welcome and embrace natural history now more than ever.

ROADS AND MULE DEER: A LOOK AT WHAT IS HAPPENING IN UTAH

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The southwestern United States is the quickest growing region of the country, with Utah coming in as the 3rd fastest growing state. Consequently, mule deer (*Odocoileus hemionus*) in Utah are faced with the challenge of adapting to a rapidly changing landscape. Roads are a predominate feature of Utah's landscapes and traffic volumes have doubled in the past 30 years. Roads with high traffic volumes can make it difficult for deer to move freely on the landscape, and most vehicle collisions with large animals in Utah involve mule deer. We discuss the impacts of roads on deer populations in Utah and implications for management. We summarize results from carcass surveys and GPS movement data. Carcass surveys were conducted throughout northern and central Utah from July 2010 to December 2011. We found that 40.1% of deer involved in vehicle collisions were adult females. All other demographic groups ranged from 10-14%. The median age for adult females deer killed in vehicle collisions was 4 years, with 95.8% of all adult females being $\leq$7 years old. Additionally, we compared carcass survey data to surveys of live deer to test if deer were being killed in proportion to their availability. We found that were 200 to 300% more bucks in carcass surveys than in live surveys, indicating that bucks may be more susceptible to vehicle collisions. We also examined the movements of 32 female mule deer in central Utah in the highway 6 corridor. We compared deer movements with correlated random walk models to test if deer were avoiding crossing roads.

Ecological Modelling of Greater Sage-grouse (*Centrocercus urophasianus*) Habitat in the State of Utah

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Concern over greater sage-grouse management has increased over recent years and Utah land managers are in the process of improving their sage-grouse protection plans. Some of the challenges to sage-grouse management in Utah include extent of potential habitat, cost of assessment and diverse land ownership (private, BLM, DWR, Forest Service, Native American, etc.). To assist with this process, we created state-wide predictive models using multiple methods to delineate potential sage-grouse habitat. Non-parametric multiplicative regression was utilized to create sagebrush presence models. Total vegetation cover models were created using generalized additive models. These were then combined with topographic and climate variables in Maxent, Hyperniche and Random Forest to delineate potential sage-grouse habitat. Finally,

multiple global climate and emission scenarios were used to identify sagebrush coverage within the state of Utah prone to future climate change. All models, with the exception of climate models, were assessed using both model strength (during creation) and validation (as defined by overall accuracy compared to field collected data). The state-wide sagebrush cover model (sagebrush greater than 5 percent) had a logβ of 6.4 and an overall accuracy of 63%. The total vegetation model had a R^2 of 0.60 and an overall accuracy of 70% (within 10% of ground data). The Maxent sage-grouse nest model had an AUC of 0.93 and an overall accuracy of 91%.

ESTIMATING MULE DEER DOE AND FAWN SURVIVAL IN UTAH

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Accurate estimates of adult and fawn survival are essential for proper management of mule deer. In December 2009, the Utah Division of Wildlife Resources initiated a statewide monitoring effort for adult doe and female fawn mule deer on 7 representative management units. In year 1 of the project, 30 adult does and 30 female fawns were collared on each unit. In each year thereafter, only female fawns were collared on each unit with adult does being supplemented as needed. All collars were monitored approximately 6-8 times per year via aerial telemetry. Adult doe survival has remained relatively constant over the past 3 years averaging 0.848 and is comparable to what is reported by other western states. Fawn survival has been much more variable averaging 0.529, 0.523, and 0.767 for 2009, 2010, and 2011, respectively. Fawn survival between units has also been highly variable with estimates ranging from 0.067 (SE = 0.05) on the Cache Unit in 2010 to 0.929 (SE = 0.05) on the Oquirrh-Stansbury in 2011. These survival estimates combined with annual fawn production data indicate that Utah's mule deer population has remained stable to slightly growing during the past 3 years with lambda averaging 1.03, 1.00, and 1.08 for the 3 previous years.

APPLICATION OF TECHNOLOGY TO DOCUMENT POLAR BEAR MATERNAL DENNING BEHAVIORS

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Studies of wildlife behavior in remote locations are frequently time intensive, logistically difficult, and expensive. Additionally, many species are difficult to locate and sensitive to the presence of researchers. We implemented novel technologies to detect and observe maternal denning behavior of polar bears (*Ursus maritimus*) on Alaska's North Slope. Parturient female polar bears give birth to altricial, neonatal young in subnivean dens during early winter. We used forward-looking infrared imagery (FLIR) to locate and confirm the presence of dens that are otherwise visually undetectable. Additionally, we plan to use Synthetic Aperture Radar (SAR) to detect denning bears. These systems detect different differences in the signatures of various materials, having the ability to see through snow and ice. After identifying den sites, we constructed autonomous camera systems to record denning behavior from breakout to departure. High definition cameras, powered by solar panels, continuously captured data throughout daylight hours. These units also have the potential to wirelessly transmit data up to five miles. To date we have observed 9 bear families, capturing many hours of behavioral footage. These systems greatly minimized our impact on bear families, while also significantly reducing the time and money needed to collect behavioral data. We

believe that these technological applications have great potential for capturing wildlife behavior when direct observation is simply not feasible, or when the risk of disturbance is high.

SURVIVAL OF GREATER SAGE-GROUSE CHICKS IN STRAWBERRY VALLEY, UTAH USING MICRO-TRANSMITTERS: DOES HANDLING TIME NEGATIVELY INFLUENCE SURVIVAL RATES?

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Research indicates that low nest success and juvenile survival of Greater Sage-Grouse may be a contributing factor to population declines. Recent technological advances in micro-transmitters have allowed researchers to monitor individual chicks and broods. We initiated a chick survival study in 2006 using micro-transmitters to (1) examine the viability of using micro-transmitters on chicks to assess survival, including the effect of handling time during the suturing process, (2) estimate overall chick survival, and (3) compare chick survival in the Strawberry Valley population to other published reports. We used a known-fate model in program MARK to estimate ĉ (over-dispersion), weekly survival rates, and 49-day survival of radio-marked chicks. Chick survival rates were lowest during the initial 3 weeks of life at which point weekly survival stabilized. Survival over 49 days was estimated at 0.25 (SE 0.10) and was comparable to estimates from other populations. Handling time was negatively associated with chick survival and chicks were 2 times more likely to survive to 49 days when handled for only 5 minutes instead of 19. We recommend researchers be judicious in using micro-transmitters, and when used, make every effort to reduce handling time.

AN ANALYSIS OF ALASKAN BEAR ATTACKS: 1983-2012

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We compiled, summarized, and reviewed 650 incidents of bear-human conflict in Alaska during 1883-2012. These incidents involved brown/grizzly bears (Ursus arctos; 512 incidents, 84%), black bears (Ursus americanus; 89 incidents, 15%), and polar bears (Ursus maritimus; 11 incidents, 2%). Bear-inflicted injuries resulted in 82 (32%) slightly injured persons, 65 (25%) moderately injured persons, 51 (19%) severely injured persons, and 60 (23%) fatalities. Brown/grizzly bears have inflicted the majority of injuries at 84% of all injuries, black bears 14%, polar bears 2%. Of fatalities, brown/grizzly bear attacks accounted for 87%, black bears 9%, and polar bears 4%. By these calculations, the 'average' brown/grizzly bear encounter is 3.5 times more dangerous than the average polar bear encounter, and 21 times more dangerous than the average black bear encounter. Our research found that both group size and habitat visibility played important roles in bear encounter probabilities. Additionally, we found that the majority of bear attacks were avoidable (59%), suggesting that better education will lead to fewer incidents.

DETECTING MOVEMENT BARRIERS FOR WILDIFE

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Human development is fragmenting wildlife habitat at an ever increasing rate. We developed a GIS tool that allows researchers to determine if animal movements are being impacted by potential barriers, such as roads. Using ESRI's ArcMap software and the freely downloadable Movement Barrier Tool, the researcher simply inputs a shapefile of animal point locations and a shapefile of linear barriers (polylines). The movement barrier tool uses this information to count how many times the animal crossed the barriers. To determine if the barriers are restricting animal movement, the tool generates a number of correlated random walks (CRW) to create a distribution of predicted barrier crossings. The actual number of crossings is then compared to the predicted number to produce a probability that the barriers are impacting animal movement. This tool provides an easy and effective way to quantify fragmentation of wildlife habitat.

Pygmy Rabbit (*Brachylagus idahoensis*) Habitat Selection in Utah: Does Sagebrush (*Artemisia sp.*) Age Influence Selection?

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The pygmy rabbit (*Brachylagus idahoensis*) is a sagebrush (*Artemisia sp.*) obligate that depends on sagebrush habitats for food and cover throughout its life cycle. Invasive species, frequent fires, overgrazing, conversion of land to agriculture, energy development, and many other factors have contributed to recent declines in both quantity and quality of sagebrush-steppe habitats required by pygmy rabbits. Given declining availability of sagebrush-steppe habitats, there is a need to identify characteristics of suitable pygmy rabbit habitat. Although habitat selection information exists from several western states, data for pygmy rabbits in Utah is limited. Moreover, a better understanding of sagebrush characteristics selected by pygmy rabbits would inform conservation efforts. We sampled 73 different habitat variables at occupied (n = 72) and unoccupied (n = 61) sites in Utah. We then used random forests to determine which variables best discriminated between occupied and unoccupied sites. Pygmy rabbits selected areas with greater amounts of horizontal obscurity (measure of cover), higher elevations, greater percent understory comprised of sagebrush and other shrubs, and lower percent sagebrush decadence in comparison to random sites. Contrary to our predictions, sagebrush age at occupied sites was not an important variable (MDA $\leq$ 1.0) and mean age did not differ by site type. We suggest managers use this information to help identify suitable pygmy rabbit habitats to further conservation of this imperiled lagomorph.

EFFECTS OF FIRE AND SMALL MAMMALS ON SEEDLING ESTABLISHMENT IN DESERT PLANT COMMUNITIES

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The invasion of exotic *Bromus* grasses has altered the fire cycle in western U.S. deserts leading to shifts in the composition of small mammal communities. Small mammals—via granivory and potentially folivory—influence and can even regulate the composition of plant communities in desert systems. However, the cascading effects of *Bromus*, fire, and shifts in small mammal communities on composition and structure of

desert plant communities and function of desert ecosystems are largely unknown. We used a randomized complete block design to evaluate the interactive effects of fire and small mammals on seed removal and survival of seedlings of common native and non-native plant species in the Mojave and Great Basin Deserts. Granivory by small mammals significantly increased seed removal. Folivory by small mammals decreased the survival of seedlings in both deserts while fire impacted survival significantly only in the Great Basin. Our results demonstrate that the influence of small mammals on the survival of desert plants extends beyond granivory to the seedling stage of the plant life cycle. In addition, there are clear indirect cascading effects, via fire and small mammals, of *Bromus* invasion on the composition and likely structure and function of these desert systems.

COUNTING SHEEP DOESN'T PUT US TO SLEEP: COMBINING REMOTE CAMERA TECHNOLOGY WITH MARK-RESIGHT METHODS

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Estimates of population size of Rocky Mountain bighorn sheep (*Ovis canadensis*) are traditionally obtained through surveys conducted from helicopters. These surveys, however, can be expensive, prone to high inter-count variation, and can have detrimental effects on the health of bighorn sheep. As advancing technology becomes progressively less expensive, it is becoming increasingly appropriate to explore alternative methods to estimate population size of these ungulates. We compared four methods of estimating the size of the population of bighorn sheep on Antelope Island State Park in northern Utah. We present the first-year results as well as our future plans for this ongoing study. We captured 40 bighorn sheep and fitted each with a radio collar with a unique identifying marker. Using these unique markers, we performed three different resight survey methods including traditional helicopter surveys (4 estimates), resight surveys conducted from the ground during the lambing season (5 estimates), and resight surveys conducted from the ground during the summer and fall months (15 estimates). In addition, we monitored 24 natural springs with remote cameras for a total of 4,560 camera days, collecting over 145,000 thousand images. We plan to develop a method to obtain estimates of population size from these collected images. We postulate that remote cameras have the potential to provide accurate, inexpensive, and non-intrusive estimates of population size when a portion of the individuals are uniquely identifiable. The final results of this study will provide many insights into the potential uses of remote cameras as a wildlife management tool for bighorn sheep as well as other species.

ANTHROPOGENIC INFLUENCES ON THE ECOLOGY OF GREATER SAGE-GROUSE IN NORTHWEST UTAH

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Populations of greater sage-grouse (*Centrocercus urophasianus*) have been declining range-wide for the last century. These declines have been largely attributed to the deterioration, loss, and fragmentation of sagebrush (*Artemisia spp.*) habitats, and greater sage-grouse now occupy less than 50% of historic range in Utah. In response to population declines, the Utah Division of Wildlife Resources (UDWR) developed a strategic statewide management plan in 2002 and the West Box Elder Adaptive Resource Management Local Working Group incorporated elements of the state plan in a local greater sage-grouse conservation

plan in 2007. The local conservation plan identified threats to the species, knowledge gaps, and conservation actions that the local group believed could reverse regional population declines; this research will addresses knowledge gaps outlined in the conservation plan. This research seeks to document vital rates, movement patterns and habitat use relative to land ownership history and habitat manipulation. The study focuses on populations inhabiting the Raft River and Pilot Mountain subunits of the UDWR Sage-grouse Management Area 1 (West Box Elder County). Greater sage-grouse will be equipped with VHF radio collars and tracked through fall of 2013 to monitor habitat use patterns, reproductive rates, and mortality rates. In addition, pellet surveys will be conducted during the summer of 2013 to increase available data for modeling habitat use relative to anthropogenic habitat manipulation and land use. Preliminary data from the 2012 season shows nesting rates of 74%, nest success of 54%, and brood success of 38%. The population is a migratory population with distinct winter/breeding and late brood rearing/late summer ranges.

Genetic consequences of translocation of greater sage-grouse in Strawberry Valley, Utah

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Greater sage-grouse (*Centrocercus urophasianus*) have declined across much of their historic range due to the loss, fragmentation, and degradation of sagebrush habitats. In central Utah, the Strawberry Valley population declined from more than 3,000 greater sage-grouse in the 1930s to less than 150 (> 95%) by the late 1990s. In 2005, a range-wide survey of greater sage-grouse suggested that the Strawberry Valley population had low genetic diversity and had undergone a recent population bottleneck. Following this discovery, recovery team partners translocated greater sage-grouse to Strawberry Valley from four different populations over 6 years (2003-2008). From March of 1998 through 2012, we captured resident male and female greater sage-grouse on and around leks in order to assess population ecology. We sampled blood from many captured individuals and extracted DNA using the Qiagen DNEasy Blood and Tissue Kit. Using seven nuclear microsatellites, we calculated allelic diversity and observed and expected heterozygosity of the population post-translocation. We hypothesized that genetic diversity of the Strawberry Valley population increased following the translocation of greater sage-grouse.

DETERMINING THE STATUS AND TREND FOR DESERT BIGHORN SHEEP IN THE NORTH SAN RAFAEL SWELL

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The North San Rafael (NSR) desert bighorn population has been steadily declining for several years. In 2001, the Utah Division of Wildlife Resources counted 326 animals, but only 150 animals in 2008. On average, annual population growth has been $\lambda = 0.89$ since 2001. In January 2012, thirty ewes and 8 rams were captured, tested for disease and fitted with GPS/VHF collars, which will be worn for 2 years. During that time the sheep will be under constant monitoring. Study objectives are to 1) locate collared females weekly to document survival, 2) locate and necropsy dead bighorns to determine causes of death and limiting factors, 3) quantify production and survival of neonates, and 4) create seasonal range use maps and an associated habitat model. Initial observations after the first year of the study are as follows. All collared ewes gave birth to lambs. Lambing dates ranged from 4 May to 9 June, with a mean date of 23 May. Lamb to ewe ratios were 45:100 in November 2012. Ten mortalities have been documented. Cougar predation

played a role in 6 mortalities, disease accounted for 1 mortality, there was 1 hunter harvest, and 2 mortalities have unknown causes. We estimate the current population to be ~130 animals. Results of disease testing show that strains of Mannheimia hemolytica and Mycoplasma ovipneumonia are present in the population and are cause for concern.

THE ROLE OF VEGETATION STRUCTURE, COMPOSITION, AND NUTRITION IN GREATER SAGE-GROUSE ECOLOGY IN NORTHWESTERN UTAH

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The greater sage-grouse (*Centrocercus urophasianus*), is the largest grouse species in North America and an important key indicator species for the condition of sagebrush (*Artemisia* spp.) ecosystems. Due to recent observed population declines, this species is a candidate for protection under the Endangered Species Act of 1973. With this decision ahead, more information is needed regarding meta-population vital rates, habitat use, and seasonal movements for the development of effective management strategies. This is the case for the meta-population of the species that inhabits west Box Elder County, northwestern Utah and is the focus of our research. This research began in January 2012 and is currently in progress. To date, a total of 80 greater sage-grouse (36 females, 44 males) have been captured and fitted with Very High Frequency (VHF) radio transmitters. Following capture, each radio-marked sage-grouse is located weekly by radio telemetry to monitor habitat selection, seasonal movements, survival, and reproductive rates. Vegetation is surveyed and sampled at actual use sites of the radio-marked birds and also at random sites for comparative purposes. The collected survey and sample data includes vegetative height and ground cover density, plant species composition, and nutritional quality of foraged plants. The data collected will provide information regarding the microhabitat characteristics preferred by greater sage-grouse in this management area and the relationship to movement patterns and vital rates. This research will provide managers with information to guide the design and implementation of management actions for the long-term conservation of the sage-grouse meta-population in this area.

MOVEMENTS AND SURVIVAL OF TRANSLOCATED MULE DEER (*ODOCOILEUS HEMIONUS*) IN CENTRAL UTAH.

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Translocation of wildlife has become common practice for wildlife managers charged with management of animals on increasingly modified landscapes. Goals of translocation projects include reducing population density to limit habitat damage or disease risk in the source area, supplementing existing populations, reestablishing populations, and introducing populations. Since the 1870's, translocations of ungulates have occurred around the world, but very little has been documented in regards to mule deer (*Odocoileus hemionus)*. Our objective is to determine if translocation is a suitable management tool for mule deer by comparing differences between survival and movement of translocated deer and resident deer. In January and March of 2013, we captured and translocated a total of 102 deer from winter range near Parowan in southern Utah to winter range near Holden in central Utah (approximately 145 kilometers). We fitted each deer with a radio transmitter (102 total: 18 GPS collars, 84 VHF collars) prior to release. As a comparative group, we also captured 50 resident deer (9 GPS collars, 41 VHF collars) during the same time period. We are monitoring radio-marked deer from each of these 3 groups over the next 2 years to evaluate habitat use, movements, and survival in relation to timing of release, age of deer, and condition of deer at time of capture. We predict that translocated deer will demonstrate different movement patterns and survival rates

compared to resident deer. Specifically, we predict that deer introduced into a novel environment will move more during the initial months following release and that these movements will be positively associated with body condition. We further predict that translocated deer will have lower survival rates compared to resident deer. Results of this study may influence the use of translocation as a management strategy for mule deer.

A Comparison of Methods to Document Activity Patterns of Post-Emergence Polar Bears (*Ursus maritimus*) in Northern Alaska

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Studies of wildlife behavior in remote locations are frequently time intensive, logistically difficult, and expensive. Additionally, many species are sensitive to the presence of researchers. We compared traditional methods of behavioral data recording with novel techniques used in a study of maternal denning ecology of polar bears (*Ursus maritimus*) on Alaska's North Slope. We located dens using aerial surveys with forward-looking infrared imagery (FLIR), ground based dog surveys, handheld FLIR, and radio telemetry. From 2002-03, one to three observers recorded bear behavior and activity from a blind using focal and instantaneous scan sampling procedures. We recorded data for 8 adult females and 5 cubs over a total of 51 observation sessions. From 2005-08, we used digital video cameras to remotely record bear activity for 11 adult females and 22 cubs from den breakout to departure. Bear-human interactions were recorded and assigned an intensity level of 1-5. Camera systems were an improvement over observations from blinds. We logged 458.8 hours of observations using blinds, and 5,784 hours of observations using camera systems; an order of magnitude more data with much less effort. We recorded 32 bear-human interactions during 2002-03 and 4 interactions in 2005-2008. Mean intensity of interactions was 1.3 ± 0.64 from 2002-03 and 2.5 ± 1.0 from 2005-08. While digital recording of behavior increased data capture and reduced total human-bear interactions, the intensity of these interactions increased, possibly due to the closer proximity of observers during camera maintenance.

WINTER LANDSCAPE USE BY RAPTORS IN WESTERN UTAH: ASSESSING HABITAT PREFERENCES IN GIS

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Understanding how raptor species use landscapes throughout the year is valuable information for wildlife managers. At HawkWatch International, we have specialized in understanding migratory and breeding preferences of raptors for over 25 years, and have begun to analyze where raptors occur and what resources they use during overwintering months in Western Utah. Raptors typically occur in higher concentrations during the winter due to reduced territoriality and may be at greater risk from localized mortality factors (e.g. electrocution, vehicle strike) than at other times of the year. We collated data from a number of sources, including HWI's winter citizen scientists and a DoD Legacy project to track Golden Eagles (*Aquila chrysaetos*) in the West Desert. We overlaid high-density areas from our 5 survey sites (e.g. Fillmore, UT [5 visits; 12 raptor species, 1,049 sightings] and Snowville, UT [7 visits; 13 raptor species; 714 sightings]) on aerial imagery, landcover and agricultural data to identify landscape characteristics associated with preferred high-volume wintering locations. For Golden Eagles, we created predictive models of winter distributions from 231 sightings recorded during 4 survey rounds between 15 November 2012 and 28

January 2013 to create maps of preferred wintering areas based on landcover, roads, powerlines and weather within the DoD airspace in Western Utah. Both analyses inform what types of landscapes and attributes are attracting raptors during the wintering months, and what weather conditions might favor raptor presence. Our results will provide managers with a complete picture of raptor ecology in the western part of the state, information to reduce risk to populations during a vulnerable time of the year, and allow for better tracking of response to landscape and climate change. We also anticipate that results from this project will be useful for outreach efforts to help landowners to attract raptors for natural pest reduction programs.

GOLDEN EAGLE POPULATION DYNAMICS IN UTAH'S WEST DESERT

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Compilation of historic nesting data (1998–2012) collected by citizen scientists and biologists in Utah's West Desert at 196 Golden Eagle (*Aquila chrysaetos*) territories has raised concerns over the species' status in the region. Breeding activity declined by 50% beginning in 2008 following a year of widespread fire and shrub loss and we found long-term eagle territory use was significantly greater in areas with more shrub cover, but less grass and fewer fires. Additionally, recent surveys (2011–2012) suggest that the abundance of the eagle's primary desert prey, the jackrabbit (*Lepus* spp.), was low in relation to historic trends, perhaps due to reduced shrub cover. Dispersal patterns gleaned from 157 band encounters suggest limited adult emigration out of the study area, although genetic data collected at 58 nest sites suggests moderate genetic diversity. Investigation of patterns of nest use at a subset of 32 territories surveyed for 25+ years confirmed a long-term decline in local breeding activity of 0.4% per year. Additionally, uninterrupted surveys at 21 territories for 26–37 years suggested that territories or individual nests should be protected for 5 or 9 years since their last documented use, respectively, to protect 95% of the inter-annual use histories observed in the dataset. We recently completed winter eagle surveys and have begun deploying 22 GPS transmitters to further refine our understanding of local Golden Eagle ecology.

Effects of sex ratio on reproduction of mule deer: Pregnancy and parturition synchrony/timing

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Mule deer (*Odocoileus hemionus*) are an iconic western species, but most populations have declined over the past several decades. Evaluating mechanisms whereby management actions influence population dynamics will further conservation of this species. For example, changes in sex ratio due to human exploitation may alter rates of pregnancy, synchrony of parturition, and timing of parturition if inadequate numbers of males are present to breed females during their first estrous cycle. If parturition is influenced by sex ratios, recruitment may be reduced (e.g., fewer births, later parturition resulting in lower survival of fawns through winter, and a less synchronous parturition that potentially increases predation of neonates). Because accurate estimates of parturition synchrony and timing are difficult to obtain in free-ranging ungulate populations (neonates are hard to detect), little data exist evaluating the relationship between sex ratio and production. Our objectives were to compare rates of pregnancy, synchrony of parturition, and

timing of parturition between mule deer populations with a relatively high (Piceance Basin, CO; 28 bucks per 100 does) and a relatively low (Monroe Mountain, UT; 14 bucks per 100 does) sex ratio. We determined pregnancy rates via ultrasonography and synchrony/timing of parturition via vaginal implant transmitters. We found no differences in rates of pregnancy (98.6% and 96.6%; $z = -0.777$, $p = 0.437$), synchrony of parturition (CV = 3.7% and 4.8%; $F = 1.172$, $p = 0.282$), or timing of parturition (mean date ± SE; June 13 ± 1.01 days and June 11 ± 1.00 days; $t = 1.641$, $p = 0.104$) between populations with a low buck:doe ratio (Monroe Mountain, UT) and a high buck:doe ratio (Piceance Basin, CO), respectively. The low buck:doe ratios observed on Monroe Mountain, UT were not associated with a protracted period of parturition suggesting that low buck:doe ratios typical of exploited populations do not influence population dynamics via rates of pregnancy or via synchrony/timing of parturition.

STATEWIDE OCCUPANCY OF RIPARIAN BIRDS IN UTAH

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Riparian systems make up <1% of land area in Utah, but riparian habitats are arguably the habitat in greatest conservation need. Over 70% of Utah's birds use riparian habitat, yet little was known about population status and trends of these species when Utah DWR initiated its 20-year riparian monitoring project. To get baseline data and evaluate trends, Utah DWR conducted point counts at 37 riparian sites across Utah, 1992 – 2011. I converted count data to presence-absence data and used the multi-season analysis function in PRESENCE to model occupancy for 48 avian species with data adequate for modeling (i.e., not too sparse or saturated). I initially ran models that included effects of year and observer to see which parameterization was most appropriate for each species, then added survey covariates (e.g. day of year, wind) and site covariates (e.g. elevation, latitude) to identify factors influencing probability of occupancy, colonization, extinction, and probability of detection. For example, probability of occupancy for broad-tailed hummingbird (*Selasphorus platycercus*) was greatest at high elevations and in the Utah Mountains ecoregion (ψ=0.49 – 0.99). In general, I did not detect any trends in occupancy; most species were in equilibrium. No species were declining in occupancy statewide, but 2 species (rock wren [*Salpinctes obsoletus*] and western scrub-jay [*Aphelocoma californica*]) were declining at some sites; though the rate of decline has slowed in recent years. Although generally site-specific, these results will give managers species lists for riparian areas and likelihood of a species occurring at sites that are relatively close to an area of interest (e.g., proposed project area). I will incorporate results from statewide riparian bird occupancy analyses, along with with species richness, abundance, and species-habitat relationship analyses, into riparian habitat guidelines. These habitat guidelines will assist managers in their efforts to assess and restore riparian systems throughout Utah.

A COMPARISON OF METHODS FOR MONITORING KIT FOXES AT DEN SITES

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Monitoring mammalian carnivores at den sites with human observers to document behavior, fecundity, litter size and natal survival is commonplace when compared to monitoring den sites with cameras. However, no

published studies exist comparing the effectiveness of human observers versus cameras in a quantitative manner. Attaining complete and reliable counts of adult and pup kit foxes (*Vulpes macrotis*) can be crucial for estimating population parameters and life history traits. In the summers of 2010 and 2011, we made weekly counts of adult and pup kit foxes at active den sites using 2 methods: (a) an observer equipped with spotting scope/binoculars, and (b) a remote infrared motion-sensitive camera. For adults and pups, we accumulated 71 and 29 counts of adults and pups at active den sites, respectively. The median number of adult and pup foxes observed at den sites with a remote camera versus an observer was similar; 2 and 1 adults/pups, respectively. We found evidence remote cameras placed at den sites for a 6-day period were more effective at obtaining higher counts for adults (Wilcoxon Test, z = -1.86, df = 1, P = 0.062) and pups (Wilcoxon Test, z = -3.13, df = 1, P = 0.002) than 1.5 hours of human observation initiated near dusk, despite the similar effort required to manage cameras and conduct observations. We recommend future surveys aimed at ascertaining more reliable counts of kit foxes and similar species at den sites use a survey methodology employing remote cameras or video over a multi-day period.

Water developments and canids in two North American deserts: a test of the indirect effect of water hypothesis

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Anthropogenic modifications to landscapes to benefit wildlife may negatively influence communities. Anthropogenic provisioning of free water (water developments) to enhance abundance and distribution of wildlife is a common management practice in arid regions where water is limiting. Despite the long-term and widespread use of water developments, little is known about how they influence native species. Water developments may negatively influence arid-adapted species (e.g., kit fox, *Vulpes macrotis*) by enabling water-dependent competitors (e.g., coyote, *Canis latrans*) to expand distribution in arid landscapes (i.e., indirect effect of water hypothesis). We tested the two predictions of the indirect effect of water hypothesis (i.e., coyotes will visit areas with free water more frequently and kit foxes will avoid areas with coyotes) and evaluated relative use of free water by canids in the Great Basin and Mojave Deserts from 2010 to 2012. We established scent stations in areas with (wet) and without (dry) free water and monitored visitation by canids to these sites and visitation to water sources using infrared-triggered cameras. There was no difference in the proportions of visits to scent stations in wet or dry areas by coyotes or kit foxes at either study area. There was no negative correlation between visits to scent stations by coyotes and kit foxes. Visitation to water sources was not different for coyotes between study areas, but kit foxes visited water sources more in Mojave than Great Basin. The intense visitation to water developments by kit foxes in Mojave challenges the commonly held view that this species does not readily drink free water. Our results did not support the indirect effect of water hypothesis in the Great Basin or Mojave Deserts for these two canids.

AMERICAN PIKA MONITORING IN UTAH USING MULTI-SEASON OCCUPANCY MODELS

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Utah has four of the five currently recognized subspecies of the American pika (*Ochotona princeps*), including the endemic *O. p. unita*. Given potential threats to pikas and their habitat, we sought to understand the distribution of and trend in pika populations statewide. We completed monitoring surveys employing multiple visits at randomly selected sites in predicted habitat during 2008 and 2011. The data supported single-season occupancy models where detection probability decreased with increasing maximum temperature and occupancy varied by subspecies, increased with latitude adjusted elevation, and increased where more of the surrounding landscape was classified as pika habitat. The estimated probability of occupancy of sites sampled in both years increased from 0.78 (SE = 0.04) to 0.92 (SE = 0.02). Colonization probability was 0.82 (SE = 0.08), whereas estimated extinction probability was 0.05 (SE = 0.03). In concurrence with metapopulation theory, sites that were less isolated and had a larger patch size had a greater probability of colonization. During targeted surveys we found pikas on 2 mountain ranges where the only known records dated to the 1960's and on several other mountain ranges we expanded the known extent of pikas. At this time, the American pika seems common in suitable habitat in Utah, and continued monitoring will allow us to document any changes in pika occupancy and direct conservation actions as needed.

FACTORS INFLUENCING THE ECOLOGY OF GREATER SAGE-GROUSE ON THE BEAR LAKE PLATEAU AND VALLEY, IDAHO-UTAH.

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The Greater sage-grouse (*Centrocercus urophasianus*, hereafter sage-grouse) was designated as a candidate species in March 2010 by the U.S. Fish and Wildlife Service. Lack of effective regulatory mechanisms to protect the species across the jurisdictional boundaries and habitat loss were singled out as two major range-wide sage-grouse conservation threats. To address these concerns may require more information about the ecology of specific populations that may inhabit multiple jurisdictions. Sage-grouse in the Bear Lake Plateau and Valley study area are found to occupy habitat in Idaho, Utah, and Wyoming. The purpose of this research is to: document population vital rates; document sage-grouse seasonal distribution and habitat-use patterns; determine if differences observed in movement and habitat-use patterns are related to sex, age class, or land-use; and document how natural and anthropogenic land-use patterns and activities may contribute to habitat loss and fragmentation of sage-grouse habitats. Radio-collared sage-grouse representative of this population were monitored from March 2010 until March 2012 to collect data on habitat use, movements, and vital rates relative to land uses, nest and brood sites vegetation structure and potential relations to success, and mortality factors. This research will be critical for sage-grouse management cooperation between Idaho, Utah, and Wyoming.